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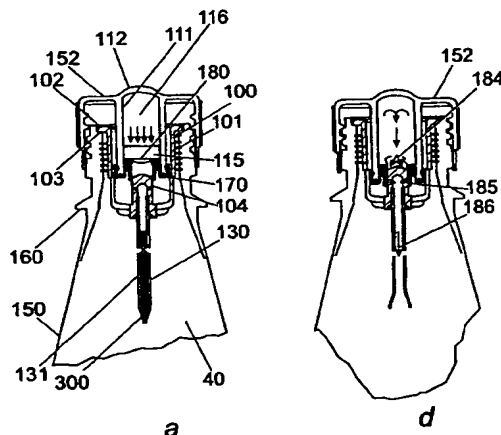
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(54) Title: **DEVICE FOR INTRODUCING A PREDETERMINED DOSE OF ADDITIVE INTO A PACKAGED LIQUID**



(57) Abstract: The invention relates to an apparatus for introducing an additive material (131) in the form of a liquid or granulated solid into a liquid (40) stored in a first container (150). The additive component (131) is stored separately from the liquid (40) in a dip tube or conduit (130). The dip tube (130) is a resilient hollow tubular member and has a valve (300) at one end, adapted to open when the dip tube (130) is subject to internal pressure to allow the passage of said additive material (131) therethrough. The valve prevents the additive material (131) from leaking or dripping into the liquid (40) in the first container (150) when the dip tube and first container are at the same pressure, but which allows the passage of liquid or pourable solid additive from the dip tube (130) into the liquid (40) in the first container (150) when the dip tube is pressurised by introduction of propellant fluid (116, 516). A second valve (520) can be used to prevent the additive material (131) from leaking or dripping into a second container (150) which is the source of the pressurised propellant fluid (116, 516).

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DEVICE FOR INTRODUCING A PREDETERMINED DOSE OF ADDITIVE INTO A PACKAGED LIQUID

1 An apparatus for introducing a predetermined dose of
2 additive into a liquid

3
4 The invention relates to an apparatus for use with a
5 container which automatically adds an additive in the
6 form of a liquid or a pourable solid to a liquid in
7 the container on opening of the container. In
8 particular the invention relates to a dip tube
9 apparatus located within the container, the dip tube
10 containing the additive and being closed at one end
11 by a valve and connected at the other end to a
12 pressure source which automatically pushes the
13 additive through the valve into the liquid in the
14 container on opening of the container.

15
16 In a wide number of applications, such as
17 pharmaceuticals for both human and animal use,
18 agrochemicals and other more general applications it
19 may be necessary to release and mix a liquid catalyst
20 or reagent into a liquid before the liquid may be

1 used. In other applications, such as in the beverage
2 industry, it may be desirable to add a component to a
3 beverage immediately before consumption of the
4 beverage, for example to effect a colour change, or
5 to create a mixed beverage which has a limited
6 storage life in the mixed state.

7
8 British Patent Application No 9823578 discloses an
9 apparatus for introducing a component into a first
10 liquid, the apparatus comprising a first container,
11 such as a bottle, which holds the first liquid. The
12 container has an opening closed by a releasable
13 closure. A second container or tank containing
14 pressurised propellant fluid is positioned in the
15 neck of the first container, adjacent to the opening.
16 A dip tube or conduit is attached to the tank, and
17 has a first end communicating with the tank and a
18 second end extending down into the first liquid in
19 the first container. The dip tube contains an
20 additive which is expelled from the dip tube into the
21 first liquid by the entry of the propellant fluid
22 from the tank into the conduit on release of the
23 releasable closure.

24
25 The preferred form of dip tube is a polypropylene
26 tube of circular cross-section, typically having an
27 internal diameter of 5.8 mm. Such a tube has an
28 internal capacity of 0.26 ml for each 10 mm length,
29 so an 80 mm long tube can hold approximately 2 ml of
30 product. The tank typically has a capacity of 2 ml,
31 and contains pressurised propellant gas.

1

2 When the tank is of an impermeable material such as
3 metal, then the headspace required for the propellant
4 gas is only a proportion of the total tank volume,
5 leaving the remainder of the tank volume as well as
6 the tube volume available for product.

7

8 However when the tank is of a material such as
9 plastic which exhibits long term permeability, then
10 the headspace required for the propellant gas must be
11 maximised, and none of the tank volume is available
12 for product. The product must all be held in the
13 tube. If a large volume of product is required it
14 may be necessary to use larger diameter dip tubes
15 capable of holding more product, and there is then a
16 need for a valve arrangement at the lower end of the
17 dip tube so that product does not drip or seep into
18 the first liquid in the first container. The use of
19 small diameter dip tubes such as capillary tubes
20 avoids the need for valves, but such small diameter
21 dip tubes can only hold a small amount of product.

22

23 Similarly if the product must be completely isolated
24 from the first liquid in the first container there is
25 a need for a valve arrangement at the lower end of
26 the dip tube so that the first liquid cannot enter
27 the dip tube by capillary action.

28

29 There is therefore a need for a dip tube apparatus
30 which has a dip tube containing the additive and
31 closed at one end by a valve, whereby the valve can

1 be readily opened when a pressure source pushes the
2 additive through the valve out of the dip tube.

3

4 According to the present invention there is provided
5 an apparatus for introducing an additive material
6 into a first liquid, the apparatus comprising:
7 a first container for holding the first liquid having
8 an opening closed by a releasable closure,
9 a second container positioned in the first container
10 and containing propellant fluid at a pressure greater
11 than atmospheric pressure, and
12 a tubular conduit having a first end communicating
13 with the second container and a second end
14 communicating with the first container;
15 wherein the conduit contains an additive material
16 adapted to be expelled from the conduit into the
17 first liquid by the entry of the propellant fluid
18 into the conduit on release of the releasable
19 closure;
20 and wherein the conduit is provided with a first
21 valve adjacent to its second end, the first valve
22 being adapted to prevent the passage of said additive
23 material into said liquid when the pressure in said
24 conduit is equal to the pressure in said liquid, and
25 the first valve being adapted to permit the passage
26 of said additive material into said liquid when the
27 pressure in said conduit is greater than the pressure
28 in said liquid.

29

30 It is to be understood that the liquid may be a gel,
31 a cream or a gel-like material.

1
2
3 In one embodiment the first container may be a bottle
4 having a neck. The second container may be a tank or
5 similar provided on the underside of the releasable
6 closure. The conduit may extend below the surface of
7 the first liquid in the bottle. Alternatively the
8 conduit may extend to a position close to the wall of
9 the first container above the surface of the first
10 liquid, to avoid foaming of the liquid and the
11 creation of pressure waves in the liquid.
12
13 In another embodiment the first container may be a
14 can. The releasable closure may be a ring pull
15 closure or other known closure suitable for use with
16 a can. The can may have a cylindrical wall and two
17 end walls, the closure being provided in one of the
18 end walls. Preferably the second container is a tank
19 attached to the inner surface of one of the end
20 walls. Alternatively the second container may be
21 freely suspended in the first liquid in the can.
22 Preferably the propellant fluid is gas. Preferably
23 the second container is placed in the can prior to
24 filling of the can with the first liquid under a
25 pressure greater than atmospheric pressure.
26
27 A second valve may be provided in the conduit
28 adjacent to the first end of the conduit, the second
29 valve being adapted to prevent the passage of said
30 additive material into said second container, and the
31 second valve being adapted to permit the passage of

1 said propellant fluid into said conduit when the
2 pressure in said conduit is less than the pressure in
3 said second container.

4

5 In one embodiment the conduit comprises a hollow
6 tubular member of resilient plastics material, the
7 first valve comprising a flattened end portion of the
8 hollow tubular member, the flattened end portion
9 comprising two opposing walls held in contact with
10 each other by the resilience of the plastics material
11 and adapted to move out of contact with each other
12 when the hollow tubular member is subject to internal
13 pressure to allow the passage of said additive
14 material therethrough.

15

16 Preferably the flattened end portion is formed by
17 applying heat to the tubular member. Preferably the
18 heat is sufficient to cause plastic deformation of
19 the material, but not sufficient to cause melt
20 bonding of the opposing walls.

21

22 The two opposing walls may be substantially planar.
23 Alternatively the two opposing walls may be arcuate
24 in transverse section, the outer surface of a first
25 one of the opposing walls being in contact with the
26 inner surface of the second one of the opposing
27 walls.

28

29 The flattened end portion may comprise one or more
30 transverse folds. Alternatively the flattened end
31 portion may be curved or bent about a transverse

1 axis. The flattened end portion may be rolled about
2 a transverse axis.

3

4 Preferably the tubular member is of plastic, most
5 preferably of polypropylene or HDPE. Preferably the
6 tubular member is of circular cross-section.

7

8 In one embodiment the first valve comprises a plug
9 means adapted to be ejected from the conduit when the
10 pressure in said conduit is greater than the pressure
11 in said liquid.

12

13 The second valve may also comprise a plug means
14 adapted to be propelled along the conduit when the
15 pressure in said conduit is greater than the pressure
16 in said liquid, thereby causing the additive material
17 to be ejected from the conduit.

18

19 The first valve may be any suitable valve means, such
20 as a poppet valve or similar. The second valve may
21 be any suitable valve means, such as a one way valve.

22

23 The conduit may contain a number of additives
24 arranged at different positions along the length of
25 the conduit. The additives are preferably liquid.
26 However the additives may be provided in granule or
27 powder form, preferably soluble. The additives may
28 be colouring agents, flavouring agents, fragrances,
29 pharmaceutical components, chemicals, nutrients,
30 liquids containing gases in solution etc.

31

1 Examples of apparatus in accordance with the
2 invention will now be described with reference to the
3 accompanying drawings, in which:-

4
5 Figs. 1(a) to 1(e) are cross-sectional views of
6 a first embodiment of an apparatus of the
7 invention, in which a container containing
8 propellant fluid is integrally formed in a
9 bottle top, showing the top before screwing on,
10 during screwing on, screwed on tight, during
11 release and fully removed respectively;
12 Fig. 2 is a cross-sectional view of the
13 embodiment of Fig. 1(a) to an enlarged scale;
14 Fig. 3 is a longitudinal cross-sectional view
15 through a first embodiment of a dip tube and
16 valve of the invention in its closed state;
17 Fig. 3a is a section on line X-X through the
18 valve of Fig. 3;
19 Fig. 4 is a longitudinal cross-sectional view
20 through a second embodiment of a dip tube and
21 valve of the invention in its closed state;
22 Fig. 4a is a section on line Y-Y through the
23 valve of Fig. 4;
24 Figs. 5 to 7 are longitudinal cross-sectional
25 views through third, fourth and fifth
26 embodiments respectively of a dip tube and valve
27 of the invention in its closed state; and
28 Fig 8 is a cross-sectional view of a second
29 embodiment of an apparatus of the invention, in
30 which the first container holding the liquid is
31 a can.

1
2 Figs. 1(a) to 1(e) show an apparatus for
3 automatically dispensing a product from a dip tube to
4 a bottle or first container by means of pressurised
5 propellant stored in a tank or second container when
6 the top is removed from the bottle. The tank or
7 second container is integrally formed with a screw
8 top which is then screwed onto the bottle or first
9 container, in the neck of which is secured an insert
10 which has a rupturing spike and a dip tube.

11
12 Fig. 1(a) shows a bottle 150 having an insert 100
13 secured within the neck 160 of the bottle, shown in
14 more detail in Fig. 2. The screw cap 152 is shown
15 separately, before closure of the bottle 150. The
16 cap 152 has an internal thread to mate with the
17 external thread on the neck 160 of the bottle. The
18 cap has an integrally moulded cylindrical portion
19 which forms an inner container 111, which is closed
20 at the upper end by a convex portion 112 of the cap
21 152, so as to resist internal pressure in the inner
22 container, and is open at the lower end 113. A
23 circumferential groove 114 is provided externally at
24 the lower end 113 of the inner container 111.

25
26 A plastic ferrule 170 comprises an inner cylindrical
27 wall 172 forming a chamber which is open at its lower
28 end and closed by a foil seal or membrane 180 at its
29 upper end. The inner cylindrical wall 172 is
30 connected and sealed at its upper end to an outer
31 cylindrical wall 174, whose outside diameter is

1 selected to fit tightly within the inside diameter of
2 the inner container 111. At the lower end of the
3 outer cylindrical wall 174 is provided a return
4 flange 176 which has a circumferential rib 178
5 adapted to cooperate with the groove 114 on the
6 outside wall of the inner container 11. The inner
7 wall 172 has upper and lower sealing ribs 182, 183
8 which are adapted to provide a pressure resistant
9 seal against the outer surface of the rupturing
10 member 104.

11
12 The ferrule 170 is secured by a snap fit to the lower
13 end 113 of the inner container 111, to provide a
14 pressure resistant closure to the container. The
15 inner container is filled with liquid 115 and
16 pressurised gas 116 in a conventional fashion, so
17 that the inner container is under internal pressure,
18 causing the foil seal 180 to bow outwards.

19
20 An insert 100 is secured by any suitable means within
21 the neck 160 of the bottle 150. The insert 100
22 comprises a substantially cylindrical housing 101
23 open at the upper end and having a number of legs 190
24 projecting from the lower end. The housing is
25 provided with detent members 191 which engage with
26 the inside of the neck 160 of the bottle, so that the
27 insert 100 cannot be readily removed. The upper end
28 of the housing has a lip 102 which is adapted to
29 engage with a recess 103 in the neck 160 of the
30 bottle, to prevent the insert from being pushed down
31 inside the neck.

1
2 The legs 190 are connected at their lower end to a
3 hollow spike member 104, which has a small diameter
4 bore portion 105 at its upper end and a large
5 diameter bore portion 106 at its lower end. Between
6 the legs are apertures which allow the passage of
7 liquid between the spike member 104 and the side of
8 the bottle when the liquid is poured from the bottle.
9 The number of legs and intervening apertures may be
10 two, three, four or more as appropriate.
11
12 Within the wall of the small diameter bore portion
13 105 are provided a number of radial passages 108
14 which communicate with the hollow interior of the
15 spike 104 and the interior of the housing 101.
16 Extending from the bottom of the hollow rupturing
17 member 104 is a dip tube or conduit 130, surrounded
18 by a plastic or sprung steel cone washer 109 which is
19 secured to the rupturing member 104 and serves as a
20 one-way retaining member to allow the conduit 130 to
21 be inserted up into the large diameter bore 106 but
22 to restrain it from being removed in a downwards
23 direction. The large diameter bore portion 106 has
24 an internal diameter equal to the external diameter
25 of the dip tube 130. The step between the large and
26 small diameter bore portions 105, 106 prevents the
27 dip tube 30 extending into the small diameter bore
28 portion 105 and blocking the radial apertures 108.
29
30 In use, the inner container 111 is filled with a
31 liquid 115 and a pressurised gas 116 by means of

1 conventional technology used to fill pressurised
2 dispenser packs, commonly known as aerosol
3 containers. Alternatively the inner container 111
4 may be filled solely with pressurised gas 116,
5 omitting the liquid 115.

6
7 Fig. 1(b) shows the cap 152 while it is being screwed
8 on to the neck 160. On application of the closure or
9 cap 152 to the bottle 150, the inner container 111 is
10 moved downwards and the spike 104 enters the space
11 formed by the inner cylindrical wall 172 of the
12 ferrule 170.

13
14 When the closure 152 is fully screwed tight on to the
15 bottle 150, the inner container 111 moves to the
16 position shown in Fig. 1(c), in which the seal member
17 154 inside the cap 152 seals tightly against the top
18 156 of the bottle neck 160. When this happens, the
19 spike 104 bursts the rupturable membrane 180 and the
20 member hollow spike extends into the inner container
21 111. In this position the liquid 115 and gas 116 are
22 prevented from escaping from the inner container 111
23 by the ferrule 170 and spike member 104 which seal
24 against each other to prevent release of the liquid
25 115 and gas 116 from the container 111. The upper
26 sealing rib 182 and lower sealing rib 183 formed
27 inside the inner cylindrical wall 172 of the ferrule
28 170 both seal against the outer surface of the spike
29 member 104.

30

1 The inner container 111 remains in the position shown
2 in Fig. 1(c) until a user releases the closure 152
3 from the bottle 150. When this occurs, the inner
4 container 111 moves to the position shown in Fig.
5 1(d). In this position the upper sealing rib 182
6 becomes unsealed from the spike member 104, but the
7 lower sealing rib 183 remains in sealing contact with
8 the outer surface of the spike member, below the
9 apertures 108. This leaves an escape passage for the
10 compressed liquid 115 (or gas 116), which is forced
11 out of the container 111 by the pressurised gas 116
12 in the direction of arrows 184, 185, 186, between the
13 spike member 104 and ferrule 170, through the radial
14 passages 108 and into the dip tube 130. The liquid
15 115 or gas 116 then passes through the dip tube 130,
16 expelling the concentrate or additive material 131
17 from the dip tube 130 through the valve 300, shown
18 schematically in Figs 1 and 2, into the liquid or
19 other substance contained in the bottle 150. On
20 removal of the closure 152, the inner container 111
21 and ruptured ferrule 170 are removed from the bottle
22 150 together, as shown in Fig. 1(e), leaving the
23 insert 100 and dip tube 130 in the bottle. The
24 insert does not impede pouring of the liquid in the
25 bottle, which can flow between the support legs 190
26 of the insert 100.

27

28 The dip tubes 130, typically thin-walled
29 polypropylene tubes such as used in the manufacture
30 of drinking straws or similar, may be of different
31 diameter or length and may contain different

1 predetermined doses of additives. However the dip
2 tubes may be larger diameter plastic tubes, holding
3 for example 10ml of additive material. The tank 111
4 may be only 2.5ml in volume, if pressurised to four
5 or five times atmospheric pressure, so that on
6 release of the closure 152 the propellant 116 expands
7 to four or five times its volume, therefore expelling
8 all the additive product 131 from the dip tube 130.

9
10 Figs 3 to 7 show five different embodiments of the
11 valve 300 provided at the lower end of the dip tube
12 130. In all cases the material 131 is held in the
13 dip tube by the flattened end portion of the dip
14 tube, and cannot exit from the dip tube until the dip
15 tube is pressurised, causing the flattened end
16 portion to open. The flattened end portion is formed
17 by applying heat to the end of the dip tube 130. The
18 heat is sufficient to cause plastic deformation of
19 the material, but not sufficient to cause melt
20 bonding of the opposing walls.

21
22 In the first embodiment of Fig. 3 the lower end of
23 the dip tube 130 is provided with a flattened, duck
24 bill shaped end portion 201. This arrangement
25 requires a significant internal pressure before the
26 valve will open, since the natural spring action of
27 the inner wall 202 means it must "pop" open away from
28 outer wall 203.

29
30 In the second embodiment of Fig. 4 the lower end of
31 the dip tube 130 is provided with a simple, planar,

1 flattened end portion 211. The heating action means
2 that the two walls 212, 213 are in equilibrium in the
3 closed position.

4
5 In the third embodiment of Fig. 5 the flattened end
6 portion 221 is folded back on itself, to provide a
7 more secure closure. A high internal pressure is
8 required, first to expand the upper portion 222 of
9 the flattened end portion 221, and then to cause the
10 fold 223 to straighten out, before the lower portion
11 224 can expand. The heating action means that the
12 fold 223 is in equilibrium in the folded position.

13
14 The fourth embodiment of Fig. 6 is similar to that
15 shown in Fig. 5, except that there are three folds
16 232 provided in the flattened end portion 231. Two
17 or four or more folds may be provided if required.

18
19 In the fifth embodiment of Fig. 7 the flattened end
20 portion 241 is rolled in a coil, which unrolls upon
21 the application of internal pressure to the dip tube
22 130.

23
24 Fig. 8 shows a partial view of a beverage can 500
25 having a cylindrical side wall 502, a lower end wall
26 504 and an upper end wall (not shown) which is
27 provided with a conventional ring pull closure (not
28 shown). Inside the can 500 a substantially
29 impervious propellant container 510, which may be of
30 metal or plastic, is secured to the inner surface of
31 the end wall 504. The propellant container 510 has a

1 single large opening 512 at its upper side, as well
2 as a very small diameter bleed hole 518 at its lower
3 side, typically 0.3mm in diameter or less. Extending
4 from the opening 512 is a dip tube or conduit 130,
5 surrounded by a plastic or sprung steel cone washer
6 514 which is secured to the rupturing member
7 container 510 and serves as a one-way retaining
8 member to allow the conduit 130 to be inserted into
9 the opening 512 but to restrain it from being removed
10 therefrom. Other methods of securing the dip tube
11 130 to the propellant container 510 may be used, in
12 place of washer 514.

13
14 After the can 500 is filled with the beverage 540,
15 liquid nitrogen is added to the beverage 540, the can
16 500 is sealed and inverted. The headspace in the can
17 reaches an equilibrium pressure P_f significantly
18 higher than atmospheric pressure. This is a known
19 technique with "widget" technology. Before filling
20 the can with beverage, the unpressurised propellant
21 container 510 and the dip tube, which contains
22 additive product 131, are both attached to the bottom
23 surface 504 of the can. The nitrogen gas in the
24 headspace slowly enters the propellant container 510
25 through the bleed hole 518 over a time of several
26 minutes, until the interior of the propellant
27 container reaches the higher pressure, so that the
28 insides of the can and the container 510 remain at
29 the higher equilibrium pressure P_f . The can may then
30 be placed the correct way up again. When the can is
31 opened by releasing the ring pull closure, the

1 pressure of the beverage in the can reverts to
2 atmospheric pressure P_a . As a result of the pressure
3 difference between the interior of the propellant
4 container 510 and the interior of the can 500,
5 propellant 516, in this case nitrogen gas, at
6 pressure P_f is forced through the opening 512 and
7 along the dip tube 130, forcing open the valve 300
8 and expelling the concentrate or additive material
9 131 from the dip tube 130 through the valve 300,
10 shown schematically in Fig 8, into the beverage 540
11 or other substance contained in the can 500. The
12 path through the dip tube 130 represents a path of
13 less resistance for the propellant 516 than through
14 the bleed hole 518, because of the small size of the
15 bleed hole 518.

16

17 To prevent additive 131 from passing into the
18 propellant container 510, a second valve (not shown)
19 may be provided in the portion 310 of the dip tube
20 130 adjacent to the opening 512. This second valve
21 may be any form of one way valve. Alternatively a
22 readily rupturable membrane (not shown) may be
23 provided at the opening 512 of the propellant
24 container, which ruptures as soon as there is a
25 greater pressure in the container 510 than outside.
26 Alternatively a plug 520, shown in dotted outline in
27 Fig. 8, such as a ball of glycerine or some inert
28 gel-like substance, may be inserted in the portion
29 310 of the dip tube 130 to prevent additive 131 from
30 passing into the propellant container 510. The plug

1 520 is driven up through the dip tube under pressure
2 from the propellant 516 on opening of the can 500.

3

4 It is envisaged that the dip tube valve arrangement
5 may find other applications, and the invention is not
6 be limited to use of the valve with the pressurised
7 dispensing devices as shown in Figs 1(a) to 1(e) and
8 Fig 8.

9

10 The invention can be used with fragrances,
11 flavouring, pharmaceuticals (particularly suitable
12 because of the accurate dosage obtainable),
13 chemicals, vitamins etc. The tubes can be filled
14 precisely at a different location and then inserted
15 into the housing at the point of filling the bottles.
16 Compressed air or other gas is particularly suitable
17 as a propellant for powdered or granulated solids, so
18 that liquid does not cause the solids to adhere to
19 the side of the dip tube.

20

21 The dip tube valve of the invention is an inexpensive
22 valve arrangement which prevents the product in a dip
23 tube from leaking or dripping into the first liquid
24 in the first container when the dip tube and first
25 container are at the same pressure, but which allows
26 the passage of liquid or pourable solid product from
27 the dip tube into the first liquid in the first
28 container when the dip tube is pressurised by
29 introduction of the propellant fluid.

30

- 1 Modifications and improvements may be incorporated
- 2 without departing from the scope of the invention.

1 **CLAIMS**

2

3 1. An apparatus for introducing an additive
4 material into a first liquid, the apparatus
5 comprising:
6 a first container for holding the first liquid having
7 an opening closed by a releasable closure,
8 a second container positioned in the first container
9 and containing propellant fluid at a pressure greater
10 than atmospheric pressure, and
11 a tubular conduit having a first end communicating
12 with the second container and a second end
13 communicating with the first container;
14 wherein the conduit contains an additive material
15 adapted to be expelled from the conduit into the
16 first liquid by the entry of the propellant fluid
17 into the conduit on release of the releasable
18 closure;
19 and wherein the conduit is provided with a first
20 valve adjacent to its second end, the first valve
21 being adapted to prevent the passage of said additive
22 material into said liquid when the pressure in said
23 conduit is equal to the pressure in said liquid, and
24 the first valve being adapted to permit the passage
25 of said additive material into said liquid when the
26 pressure in said conduit is greater than the pressure
27 in said liquid.

28

29 2. An apparatus according to Claim 1, wherein the
30 liquid is a gel or gel-like material.

31

1 3. An apparatus according to Claim 1 or 2, wherein
2 the first container is a bottle having a neck, and
3 the second container is provided on the underside of
4 the releasable closure.

5

6 4. An apparatus according to Claim 3, wherein the
7 conduit extends below the surface of the first liquid
8 in the bottle.

9

10 5. An apparatus according to Claim 1 or 2, wherein
11 the first container is a can and the releasable
12 closure is a ring pull closure.

13

14 6. An apparatus according to Claim 5, wherein the
15 can has a cylindrical wall and two end walls, the
16 second container being attached to the inner surface
17 of one of the end walls.

18

19 7. An apparatus according to any preceding Claim,
20 wherein a second valve is provided in the conduit
21 adjacent to the first end of the conduit, the second
22 valve being adapted to prevent the passage of said
23 additive material into said second container, and the
24 second valve being adapted to permit the passage of
25 said propellant fluid into said conduit when the
26 pressure in said conduit is less than the pressure in
27 said second container.

28

29 8. An apparatus according to any preceding Claim,
30 wherein the conduit comprises a hollow tubular member
31 of resilient plastics material, the first valve

1 comprising a flattened end portion of the hollow
2 tubular member, the flattened end portion comprising
3 two opposing walls held in contact with each other by
4 the resilience of the plastics material and adapted
5 to move out of contact with each other when the
6 hollow tubular member is subject to internal pressure
7 to allow the passage of said additive material
8 therethrough.

9

10 9. An apparatus according to Claim 8, wherein the
11 flattened end portion is formed by applying heat to
12 the tubular member.

13

14 10. An apparatus according to Claim 8 or 9, wherein
15 the two opposing walls are substantially planar.

16

17 11. An apparatus according to Claim 8 or 9, wherein
18 the two opposing walls are arcuate in transverse
19 section, the outer surface of a first one of the
20 opposing walls being in contact with the inner
21 surface of the second one of the opposing walls.

22

23 12. An apparatus according to Claim 8 or 9, wherein
24 the flattened end portion comprises one or more
25 transverse folds.

26

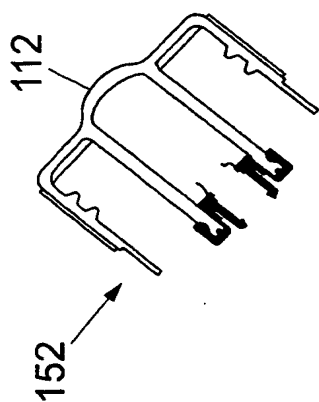
27 13. An apparatus according to Claim 8 or 9, wherein
28 the flattened end portion is curved, bent or rolled
29 about a transverse axis.

30

1 14. An apparatus according to any one of Claims 1 to
2 7 wherein the first valve comprises a plug means
3 adapted to be ejected from the conduit when the
4 pressure in said conduit is greater than the pressure
5 in said liquid.

6
7 15. An apparatus according to Claim 7 wherein the
8 second valve comprises a plug means adapted to be
9 propelled along the conduit when the pressure in said
10 conduit is greater than the pressure in said liquid,
11 thereby causing the additive material to be ejected
12 from the conduit.

13
14
15 16. An apparatus according to any one of Claims 1 to
16 7 wherein the first valve comprises a poppet valve or
17 similar.



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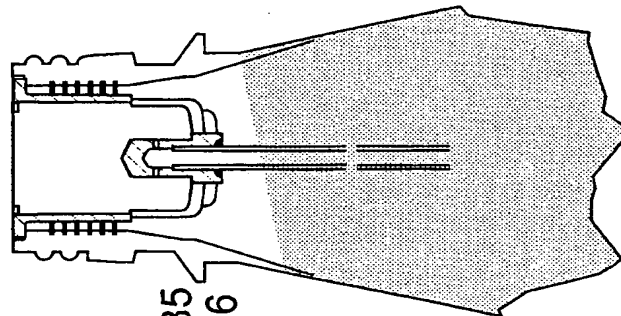


Fig. 1e

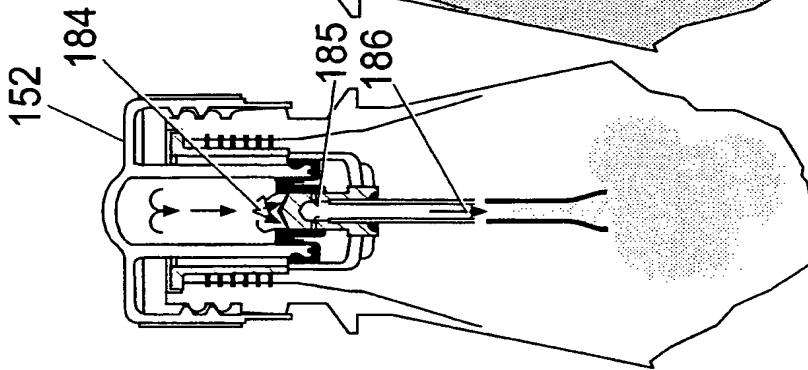


Fig. 1d

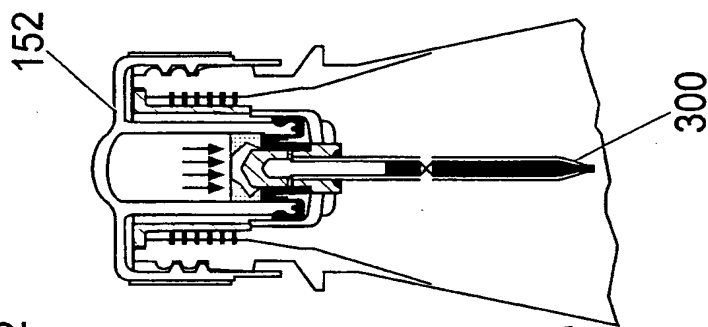


Fig. 1c

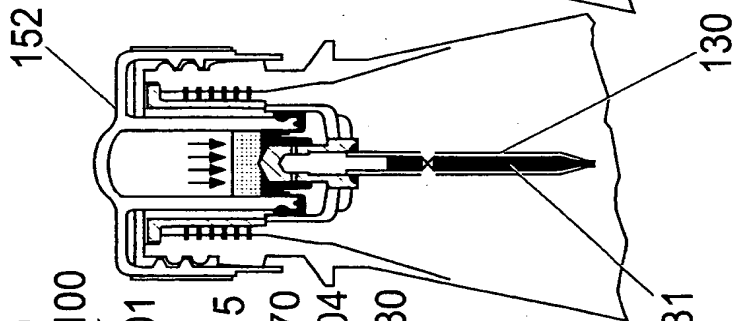


Fig. 1b

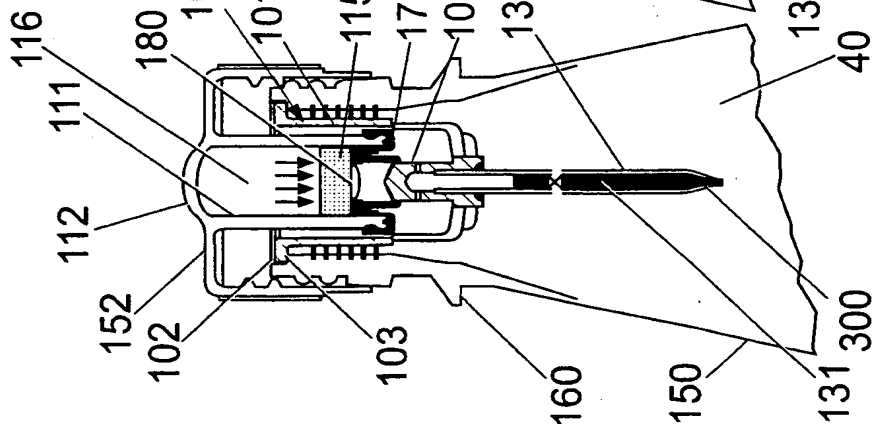


Fig. 1a

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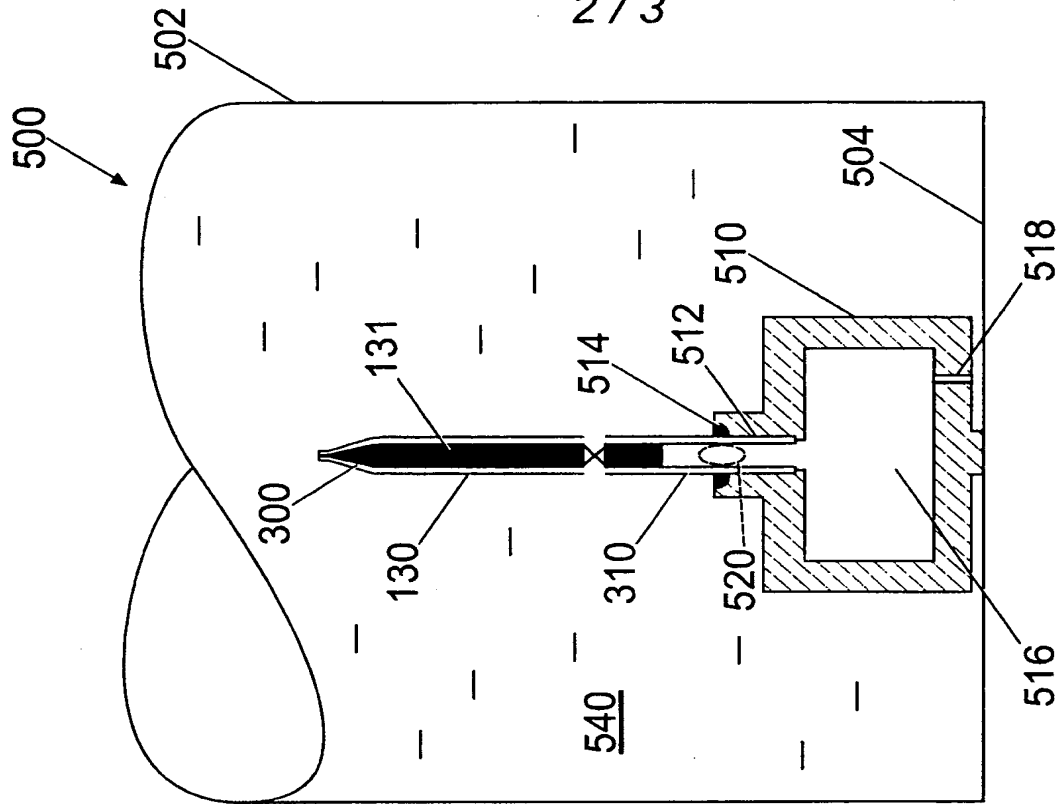


Fig. 8

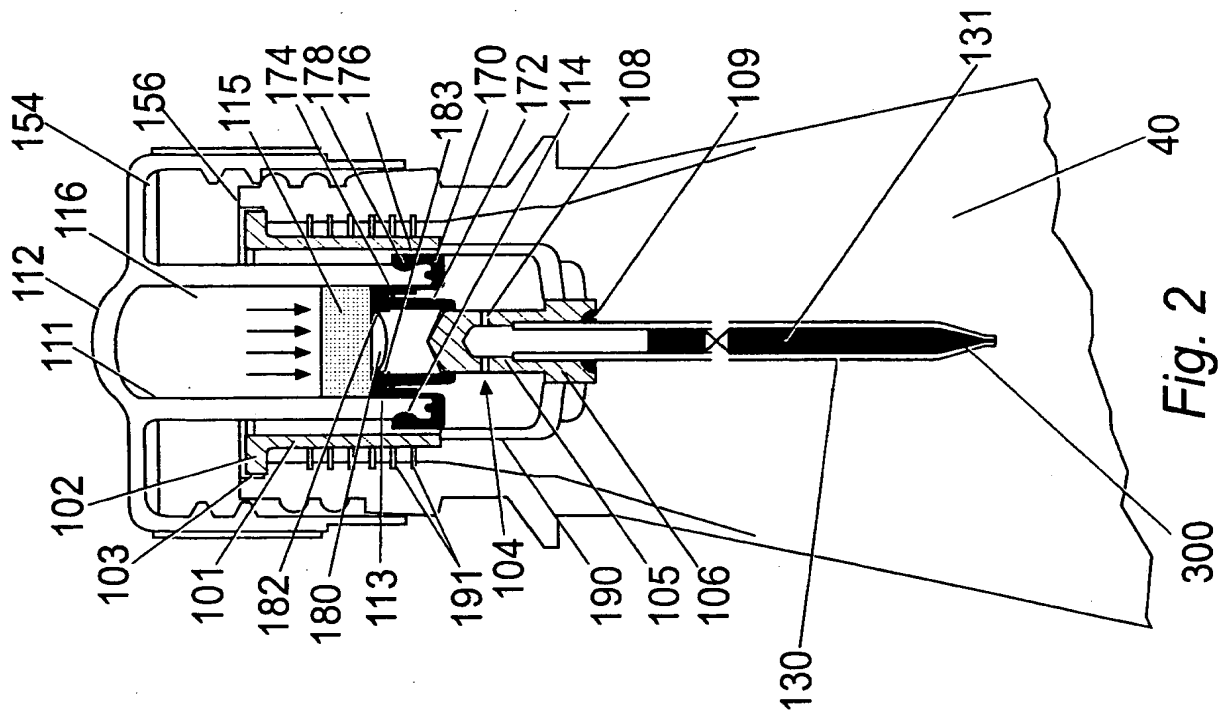
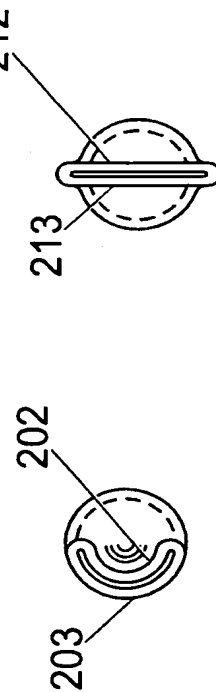
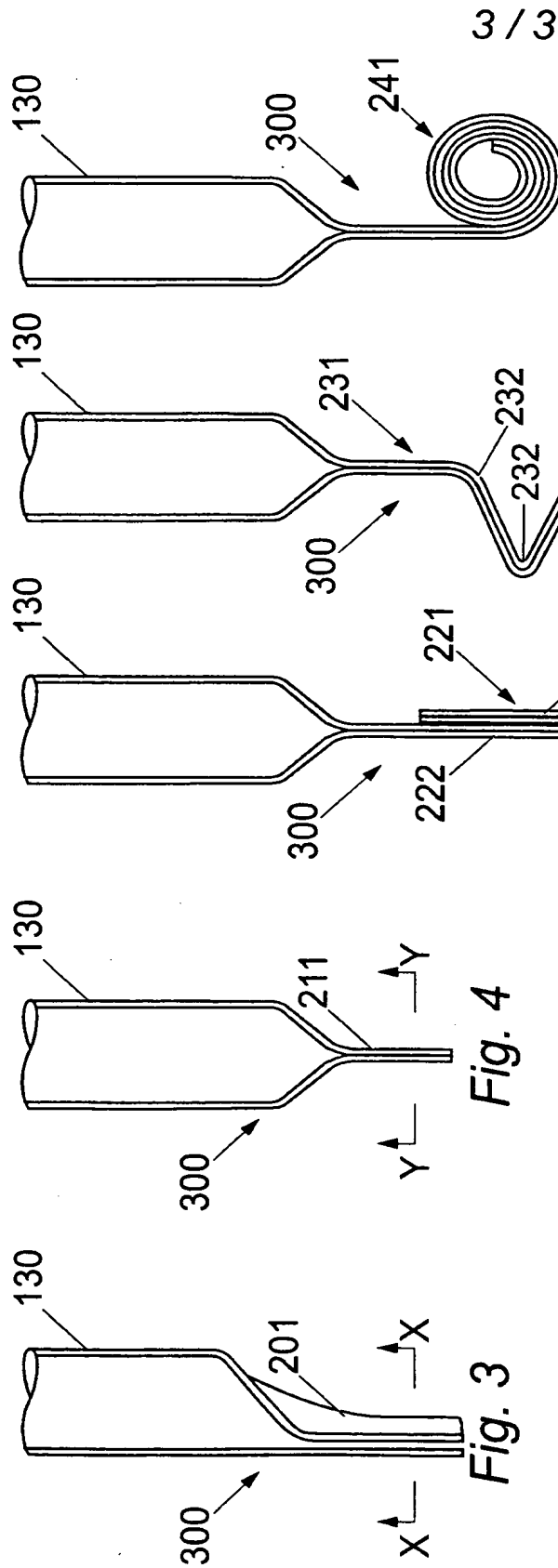


Fig. 2

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 00/02285

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B65D51/28 B65D79/00 B65D47/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

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Y	US 5 725 896 A (BANKS ANTHONY J) 10 March 1998 (1998-03-10) the whole document	5, 6, 16
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Y	US 4 592 493 A (SMITH ROBERT C) 3 June 1986 (1986-06-03)	8-11, 13
A	the whole document	12
-/--		

☒ Further documents are listed in the continuation of box C.

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Date of the actual completion of the international search

3 October 2000

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

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